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DOCUMENT-IDENTIFIER: US 6277732 B1

TITLE: Method of planarizing inter-metal dielectric layer

Brief Summary Text (13):

To achieve these and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, the invention provides a process for planarizing an inter-metal dielectric layer. A substrate having a plurality of metal lines thereon is provided. Some metal lines are formed close to each other, resulting in densely packed metal line regions. In contrast, some of the metal lines are laid further apart, resulting in loosely packed metal line regions. A dielectric liner layer is formed covering the metal lines and the exposed substrate. A nitridation treatment of the dielectric liner layer is carried out. Organic dielectric layer having a low dielectric constant is deposited over the dielectric liner layer so that the densely packed metal line regions are completely filled while the loosely packed metal line region is only partially filled. Using the dielectric liner layer as an etching stop layer, the organic dielectric layer is etched by performing a reactive ion etching operation. Inorganic dielectric layer having a low dielectric constant is deposited over the organic dielectric layer. The inorganic dielectric layer has a thickness greater than the height of the metal lines. A cap dielectric layer is formed over the inorganic dielectric layer, and the cap dielectric layer is planarized by performing a chemical-mechanical polishing operation. A via is formed through the cap dielectric layer, the inorganic dielectric layer, the organic dielectric layer and the dielectric liner layer such that a top surface of the metal line is exposed. An electron beam curing operation is carried out so that the organic dielectric layer on the sidewall of the via is more dense. Lastly, a barrier layer and a metal plug are sequentially formed inside the via.

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